A COMPARATIVE STUDY IN MATHEMATICAL COMPETENCIES OF SIMILAR STUDENTS USING TRADITIONAL AND MODERN MATHEMATICS AT GLICK ELEMENTARY SCHOOL, MARSHALLTOWN

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by

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

The new mathematics program established within the school curriculum has received considerable debate. A difference of opinion exists among educators as to whether the new mathematics program is developing the reasoning and/or computational skills of the students as compared to the previous mathematics program.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study to determine whether the new mathematics program at Glick School, Marshalltown, Iowa, has produced students with better computational skills and/or a better understanding of mathematics.

Importance of the study. The study was designed to evaluate the presumptions of several Glick teachers who had stated that students appeared to be gaining in mathematical understanding since the new mathematics program was established, but that the students' computational skills were not so good as students who were studying under the conventional program.

The following information was obtained when the Glick teachers replied to this request--"State your opinion concerning the students' understanding of mathematics and their computational skills under the old math program as compared to the new math program."

One teacher stated, "Accuracy is lower than understanding in new math as testing usually shows." A third grade teacher said:

> I know of no substitute for drill for helping children develop facility in computing. We know understanding is the main objective, but after a child understands a process he needs practice until he becomes proficient. Many teachers are so busy keeping up with over verbalized text books, that not enough time is given to drill.

Another teacher stated:

> The content in the new is more abstract and mathematical. Gives greater emphases to learning the fundamental structural properties. . . . The new tests include more mature terminology. Fourth grade enjoys this. I believe the students understanding is good, especially those having had new math through the primary grades. Some are poor in computational skills. I believe this comes from poor working habits. . . . not the text, really.

The following statement was by a fifth grade teacher:

> I feel at fifth grade level the child has a very good background for following through the steps in problem solving because they have been asking "why?" and discovering reasons for conclusion from kindergarten on up through fourth grade in our system. This was not true of the "old math" text used previously.
>
> The text itself Modern Arithmetic Through Discovery[1] does not give enough follow up exercises

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[1]Robert Lee Morton, Merle Gray, and Myron F. Rosskopf, Modern Arithmetic Through Discovery (Morristown, N. J.: Silver Burdette Company, 1965).

> when presenting new material. . . .Our achievement test scores indicate a weakness in computation skills.

Children like math class when new math is used.

Another teacher stated briefly, "I think the new books spend too much time on exploration and the discovery method and understanding with too little time on computation not enough practical application."

Although the teachers quoted did not agree on the cause, they voiced the opinion that the computational skills of the students were not so good as their understanding of the processes.

II. LIMITATIONS

With a study of this nature there are several limitations that must be considered. The limitations that the researcher evaluated are: Does the test favor modern or traditional mathematics? Are the teachers the same? Are the Intelligence Quotients of the students approximately the same? Is the school population approximately the same?

The test. The scores used for the comparison study were results obtained by the students when the Stanford Achievement Test was administered to the third and sixth grades as part of the Marshalltown Community

Schools' testing program. The Sixth Mental Measurement Yearbook was consulted to determine whether the Stanford Achievement Test was designed to evaluate the traditional mathematics curriculum or the modern mathematics. Miriam M. Bryan, Associate Director of Test Development, Educational Testing Service, Princeton, New Jersey, analyzed the test as follows:

> The content of the arithmetic tests through the Intermediate 2 Battery, though of high quality does not reflect enough of the widespread contemporary trends in the elementary curriculum. Noticeably missing at these lower levels are such areas as the number line, inequalities, some of the structure of the number system, and the properties of numbers. Strangely the Primary 1 and 2 Batteries appear to have greater content Breadth than the Intermediate 1 and 2 Batteries.[1]

It should be noted that the teachers at Glick School had based their presumptions on the results of the Stanford Achievement Test, even though the test did not adequately evaluate the new mathematics program.

The teachers. Between the school year 1962-1963 and 1966-1967 there had been a change of three teachers, a second grade teacher, a fourth grade teacher, and a sixth grade teacher out of the thirteen teachers for the grades kindergarten through sixth at Glick School. As the interpersonal relationship between child and teacher,

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[1] Oscar K. Buros, The Sixth Mental Measurement Yearbook (Highland Park, N. J.: Gryphon Press, 1965), p. 118.

resulting in some pupils performing better with certain teachers than with others, is at the heart of the learning situation,[1] the change in teachers could have bearing on the outcome of the study. To sufficiently evaluate the different teaching techniques and knowledge of subject matter[2] of the teachers would, in itself, be an extensive research study. Thus the researcher acknowledges that this is a variable in the study.

The students' Intelligence Quotients. The "intelligence quotient is a measure of the mental brightness of an individual"[3] and provides an approximation of relative abilities of children at a particular time.[4] The Intelligence Quotient scores of the individual students were acquired from the accumulative school records. The scores were obtained when the Otis Quick Scoring Mental Ability Test, Beta Form was administered to the

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[1]Herbert A. Thelen, "Matching Teacher and Pupils," NEA Journal, LVI (April, 1967), 18-20.

[2]"Methods of Teaching," Encyclopedia of Educational Research, ((third edition; New York: MacMillan Company, 1960), pp. 848-849.

[3]Guidance Handbook for Elementary School, prepared by the Division of Research and Guidance (Los Angeles: California Test Bureau, 1948), p. 134.

[4]Roma Gans, Celia Burns Stindler, and Millie Amy, Teaching Young Children (Younkers, N. Y.: World Book Company, 1952), p. 20.

third and sixth graders, as was the policy of the Marshalltown Community Schools. Although the scores on standardized group intelligence tests, such as Otis, are not considered to give so accurate a score as an individual intelligence they do yield comparable scores.[1] The scores can be a useful tool, as:

> General mental ability tests are widely used to predict a child's ability to succeed in different elementary school subjects. . . .In a summary of the relationship between scores on such tests and achievement in various subjects Louttit reported medians of the co-efficient of correlation between intelligence tests scores and ability in a number of school subjects as follows: reading .60, spelling .51, arithmetic .55, and handwriting .10.[2]

The intelligence quotients of the different classes were compiled and the mean Intelligence Quotient of each group was found. The results are as follows: Third grade, 1962-63, 102; third grade, 1966-67, 107; Sixth grade, 1962-62, 112; sixth grade, 1966-67, 107. The individual Intelligence Quotient scores of these four groups are listed in the Appendix.

A variance of five points is noted between the two third grades and between the two sixth grades. The third grade 1966-67 and the sixth grade 1962-63 had the higher intelligence quotient means.

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[1] Providing for Individual Differences in the Elementary Classroom Edited by Norma E. Cutts and Nicholas Moseley (Englewood Cliffs, N. J.: 1961), p. 28.

[2] "Methods of Teaching," Encyclopedia of Educational Research (revised edition; New York: MacMillan Company, 1950), p. 878.

The school population. A brief study of the school population at Glick School revealed that many of the families lived in rental houses within the Glick area. Although there was moving from house to house, the socio-economic status of the families renting these houses were very similar. Thus the researcher considers the socio-economic level of the population of Glick in 1966-67 much the same as that of the 1962-1963 school population. Since scholastic achievement of pupils in school at all grade levels from first to twelfth is positively correlated with socio-economic ratings of their homes,[1] the investigator considered this one phase of the school population.

III. DEFINITION OF TERMS USED

The researcher has designated the groups whose scores are used for the comparison within this study as: A--the third grade students at Glick School during the 1962-1963 school year; AX--the third grade students at Glick School during the 1966-1967 school year; B--the sixth grade students at Glick School during the 1962-1963 school year; BX--the sixth grade students at Glick School during the 1966-1967 school year.

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[1]James B. Stroud, Psychology In Education (New York: Longmans, Green and Company, 1946), p. 412.

IV. ORGANIZATION OF REMAINDER OF THE STUDY

Chapter II will deal with the survey of the literature related to the new mathematics, establishing the major reasons for the changes taking place in the new mathematics curriculum and the main objectives of the new mathematics program. The second chapter also will present a review of investigations similar to the problem of this study.

Chapter III will contain data showing test scores results in the two areas of mathematics, computational skills and mathematical reasoning and understanding, received by the four groups, A, AX, B, and BX. These results have been compared by use of a t-test to determine differences apparent in either of the two areas of mathematics, since the new mathematics program was put in effect at Glick School in September, 1963.

The final chapter, Chapter IV will include a summary of the report, conclusions reached, and recommendations.

CHAPTER II

RELATED RESEARCH

The need for advanced scientific knowledge within the American society has brought about a change in the mathematics curriculum of the elementary school. This change of curriculum has been called "modern arithmetic" or "the new mathematics." The reasons for these changes and the main objectives of the new mathematics curriculum, as well as many studies on the new mathematics program, have been published in educational journals, books, and pamphlets.

I. RESEARCH ON THE NEW MATHEMATICS PROGRAM

Since the beginning of the revolution in school mathematics,[1] educators have been asking questions such as: Is a modern program in arithmetic really necessary? If so, why? The new approach to arithmetic was necessary and for a variety of reasons. Some reasons concern national interests and our need for competing with other nations of the world. Others center on our need for mathematics on a personal level--both as wage earners

[1]Carl B. Allendoerfer, Mathematics for Parents (New York: The Macmillan Company, 1965), p. 164.

and as citizens. Still others lie in the fact that a modern program affords easier and more effective ways of teaching arithmetic than were formerly at our disposal.

Today's culture is a "mathematized" culture. New and startling technological and scientific developments are occurring daily. An ever increasing number of trained scientists and technicians are needed. There must be a constant flow of trained men and women to design, build, and maintain the electronic computers, atomic powered conveyances, and the satellites. There are uses for mathematics today that were unheard of or even thought about a few years ago. Chemists and physicists have found new uses and interpretations for mathematics, biologists are applying mathematics to the study of genetics, business men are using mathematics in scheduling production and distribution, and sociologists are using statistical ideas.[1]

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[1] Ibid., pp. 26-29; Max Broder, "What About the New Mathematics?" High Points, XLVIII (January, 1966), 45; Henry Van Engen, Maurice L. Hartung, and James E. Stochl, Foundations of Elementary School Arithmetic (Chicago: Scott, Foresman and Company, 1965), pp. 1-4; and Donald E. Skipp and Sam Adams, Developing Arithmetic Concepts and Skills (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1964), p. 392.

Because our nation is committed to intensive scientific and technological progress, it is essential that the children's potential for mathematics be fully developed.[1] As adult citizens, they will need mathematics to make intelligent decisions and to understand the technical culture surrounding them.[2] This development of mathematical potential will make it possible for them to pursue careers that are dependent upon mathematical skills and abilities. These include trades, professions, and scientific or academic careers. Children must acquire a liking for, an interest in, and an inclination for mathematics at the grade school level to encourage their studies of mathematics to continue in high school and college.[3] Thus, it is in the elementary school that a solid foundation in mathematics--the new mathematics or modern arithmetic--must be established.

"Modern arithmetic" refers to a modern program in arithmetic--a program that differs from traditional

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[1] Harry L. Phillips and Marguerite Kluttz, Modern Mathematics and Your Child (Washington, D. C.: United States Department of Health, Education and Welfare, 1963), p. 5.

[2] A Service Report for Schools (St. Louis, Missouri: Webster Publishing Company), p. 1.

[3] Foster E. Grossnickle and Leo J. Brueckner, Discovering Meanings in Elementary School Mathematics (Chicago: Holt, Rinehart and Winston, Inc., 1964), p. 9.

programs in both content and spirit. It is a program that reflects new points of view and new emphases. "The new mathematics" should not be misconstrued to mean new and startling developments introduced at the elementary level, but that many of the basic operations and concepts are given a new twist.[1]

The new or modern applies not so much to the content as to the teaching through a modern spirit, a spirit of inquiry, of discovery, of adventure[2] that is instilled in pupils through an inductive approach. It has to do with helping them use ideas already acquired as a means of discovering new ideas. It involves helping them understand the meaning of what they are asked to do. It calls for developing in them a sensitivity to patterns among numbers. A modern program introduces some mathematical concepts earlier than was previously considered feasible. However, an arithmetic program that is merely accelerated is not necessarily modern.[3]

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[1]Phillips, op. cit., p. 3.

[2]Donald J. Inbody, "Helping Parents Understand New Mathematics," Arithmetic Teacher, XI (December, 1964), 530.

[3]Ralph T. Heimer and Miriam S. Newman, The New Mathematics for Parents (Chicago: Holt, Rinehart and Winston, Inc., 1965), p. 109.

Arithmetic is a system of related ideas.[1] These ideas are not acquired through the repetition of the words of someone else. They are acquired as a result of the kind of thinking that is done when the ideas already acquired are used as a means of discovering new ideas. The modern arithmetic program helps pupils learn to add, subtract, multiply, and divide through the study of numbers and the relationship that exists among numbers.[2] Children learn through discovery[3] as they explore various relationships among numbers, and they practice what they have learned as they continue to explore these relationships. The modern content gives children some understanding of the structure that underlies and unifies mathematics.[4]

A modern program takes into account results of recent research proving that children find elementary mathematics extremely interesting.[5] It also provides

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[1]Robert Lee Morton, Merle Gray, and Myron F. Rosskopf, Modern Arithmetic Through Discovery: Book Two (Morristown, N. J.: Silver Burdette Company, 1965), p. iii.

[2]Phillips, op. cit., p. 6.

[3]Howard F. Fehr, "Modern Mathematics and Good Pedagogy," Arithmetic Teacher, X (November, 1963), 407.

[4]Grossnickle, op. cit., p. 10.

[5]Phillips, op. cit., p. 6; and Lyla Lynch, "Arithmetic By Television," Arithmetic Teacher, X (January, 1963), 28.

for applying the arithmetic they learn to the world around them.[1] The sharper focus on fundamental concepts and principles[2] in a modern program is conductive to deeper understanding and also makes it possible to cover more ground. The new mathematics is also planned to recognize and make provisions for individual differences.[3]

The modern elementary mathematics program has many elements. One aspect of the modern program that is readily apparent is the precise use of vocabulary.[4] The emphasis placed on the exact use of words is important. Language helps pupils think in arithmetic, just as it does in any other area. The use of exact language to describe an exact science enables pupils to communicate ideas clearly and precisely and serves as a valuable tool for seeing mathematical relationships in greater depth.

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[1]Edwina Deans, Elementary School Mathematics (Washington, D. C.: United States Department of Health, Education, and Welfare, 1963), p. 4.

[2]Heimer, op. cit., p. 109.

[3]Wilbur H. Dutton, Evaluating Pupils' Understanding of Arithmetic (Englewood Cliffs, N. J.: Prentice-Hall, 1964), p. 19.

[4]Inbody, op. cit., p. 532.

Great emphasis has been placed on another element of the new mathematics program--understanding our decimal numeral system.[1] The distinction between a number, which is an idea, and a numeral, which is a name for that idea, is essential in the use of our numeration system. Pupils must be helped to understand that the number "eight" can be named by the numeral 8, or by any of an endless variety of expressions, such as: 4 + 4, 12-4, 4x2, 24÷3. Pupils must understand the idea that a figure such as 7 may mean seven ones, seven tens, seven hundreds or seven millions; depending on its place in a numeral. Gradually pupils discover that a place in a numeral has ten times the value of the place to the right of it.[2] This understanding of place value is important to achieve proficiency in working the basic operations--addition, subtraction, multiplication, and division and "is essential for continuous growth in mathematics."[3]

Carefully defining certain basic principles[4] is another aspect of the modern arithmetic program. A

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[1] Deans, *op. cit.*, p. 4.

[2] Grossnickle, *op. cit.*, p. 55-59.

[3] *Ibid.*, p. 79.

[4] Deans, *op. cit.*, p. 4.

systematic plan is followed for helping children learn to use the basic principles such as: commutative principle, associative principle and distributive principle.[1] More emphasis is placed on principles than formerly for two reasons: to give the child tools for building new facts and concepts from what he already knows and to give the child some appreciation of the basic structure of mathematics.[2]

Introducing the concepts of sets informally as a means of deepening children's understanding of number relationships and nature of our numerations system[3] is a characteristic of the new mathematics program. The idea of sets, though, is not new, as "George Cantor developed the theory of sets toward the end of the Nineteenth Century."[4] Children are also helped to understand and use the concept of subsets. The concept of sets prepares children for the mathematics of later grades, where they will use symbols to define sets of members and where set language is a powerful tool for expressing abstract ideas.[5]

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[1] Allendoerfer, op. cit., p. 15.

[2] Grossnickle, op. cit., p. 72-74.

[3] Ibid., p. 15, 95-96.

[4] Heimer, op. cit., p. 13.

[5] Grossnickle, op. cit., p. 15.

Exploration of certain basic geometric concepts is the final element of the new mathematics program that will be discussed by the investigator. Studies have shown that "informal geometry of shape can be taught effectively in the elementary school."[1] It is not enough in a modern arithmetic program for children to be able to identify geometric shapes. They must also learn to recognize their characteristics, or properties. An extensive use of the discovery approach allows children to measure geometric figures and then draw conclusions from their measurements. This discovery approach adds much to the child's enjoyment of geometry. Other sources of enjoyment for him lie in seeing geometric shapes in the things around him,[2] and in drawing circles, rectangles and triangles. Geometric concepts are developed gradually, simply, and intuitively in the elementary grades. "The value of geometry is that it introduces 'analytical and creative thinking' at the primary grade level. The important concept of precision is introduced in a most effective manner."[3]

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[1] *Ibid.*, p. 4.

[2] *Ibid.*, p. 14.

[3] *Ibid.*, p. 114.

A few of the modern aspects of "the new mathematics" or "modern arithmetic" program have been discussed. A modern program reflects a new and deeper concern for how children learn, emphasizing that understanding is more important than "memorization of facts."[1] The program represents a selection of topics that can be taught most appropriately in each elementary grade.[2] Mathematics is more interesting, more stimulating, more challenging, and more meaningful[3] than that experienced by children in the past. Arithmetic is no longer a grim business--it is fun. When children are allowed to discover, try out, and puzzle over problems, arithmetic becomes a game--a game that results in lasting learning.

II. RESEARCH ON RELATED INVESTIGATIONS

There have been many experimental programs and studies evaluating different phases of the new mathematics program. The remainder of this chapter will be concerned with such studies.

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[1] Van Engen, _op. cit._, p. 4.

[2] _An Analysis of New Mathematics Programs_ (Washington National Council of Teachers of Mathematics, 1963), pp. 2-3.

[3] Betty Atwell Wright, "Anatomy of Change in Elementary Mathematics," _Arithmetic Teacher_, X (March, 1963), 159.

A study of children's attitude toward arithmetic[1] was made by Arbego, a fourth grade teacher at Anza School in El Cajon, California. The purpose of the study was "to compare attitudes of students toward traditional arithmetic to their attitudes toward modern mathematics."[2] The hypotheses developed and tested in the study were:

1. There is no difference between the ranking of traditional arithmetic and modern mathematics in subject preference.
2. Students who achieve in mathematics have a positive attitude toward mathematics, whether it be traditional arithmetic or modern mathematics.
3. At the fourth grade level there is no difference between boys and girls in attitudes, whether they are studying traditional arithmetic or modern mathematics.[3]

Twenty-four subjects completed the study during the spring of 1965. The range of the students achievement was from low average to high average. Traditional arithmetic was taught these students until March 1, 1965. Then a unit on modern mathematics was taught for a six-week period, ending April 9, 1965.

A subject preference rating list, composed of six fundamental subjects; an attitude questionnaire; and the Stanford Achievement Test, Form J (March 1) and Form K (April 9) were administered to the subjects. These results were used to test the hypotheses.

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[1]Mildred Brown Arbego, "Children's Attitudes Toward Arithmetic," Arithmetic Teacher, XIII (March, 1966), 206.

[2]Ibid., p. 207. [3]Ibid.

The Spearman rank difference method produced a _rho_ of .71 on the subject preference. At the .05 level of confidence this correlation is significant. "It would suggest that students who liked traditional arithmetic also liked the new mathematics, even though it was quite different.[1]

A _z_ of -.40 was obtained when the Mann-Whitney U formula was applied to the ranking of attitudes taken from the subject preference rating list. "This would indicate that the ranking of attitudes toward traditional and modern mathematics was similar."[2]

The Pearson product-moment correlation coefficients were used when the scores taken from the Stanford Achievement Test, Form J were compared to attitude scores obtained from the questionnaire. A correlation coefficient of -.18 was found. A correlation coefficient of -.17 was derived when the scores from Form K were compared to the attitude scores. "Since the correlations are not significant, there appears no relationship between achievement and attitudes toward traditional arithmetic or modern mathematics."[3]

To test the hypothesis that at fourth grade level there is no difference between boys and girls in attitudes

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[1] _Ibid._ [2] _Ibid._

[3] _Ibid._, p. 208.

toward traditional arithmetic, the Fisher t-score was applied and a $\underline{t}$ of .90 was obtained. This result indicates no significant difference. A $\underline{t}$ of .34 was obtained when attitudes toward modern mathematics was tested. This, again, was not significant.[1]

Another study concerning achievement in the modern mathematics program was reported by Peck.[2] Peck's study was developed to evaluate the use of new mathematics materials in the elementary schools of Kanawha County, West Virginia, where three pilot programs in the new mathematics had operated during the 1961-1962 school year. Data for the study were obtained from the Otis Quick Scoring Mental Ability Test, Beta Form, administered October, 1961, to all sixth grade Kanawha County students; and the Stanford Achievement Test, Form J administered April 24, 1962, to an experimental group of sixth grade students selected to study the modern mathematics and a randomly selected control group from the total Kanawha County sixth grade. The students' achievement in arithmetic was evaluated by:

> matching students studying the new mathematics units on the basis of scores made on the Otis Test with randomly selected pupils throughout

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[1] Ibid.

[2] Hugh I. Peck, "An Evaluation of Topics in Modern Math," Arithmetic Teacher, X (May, 1963), 277.

Kanawha County in the same grade. The achievement test scores in arithmetic reasoning and arithmetic computation of these matched pairs were then compared.[1]

The test score results were as follows:

MEAN OTIS INTELLIGENCE QUOTIENT AND MEAN STANFORD ARITHMETIC GRADE EQUIVALENTS

	CONTROL GROUP			EXPERIMENTAL GROUP		
n	Otis	Reasoning	Computation	Otis	Reasoning	Computation
29	113	8.2	8.0	113	7.9	7.2
31	121	8.7	8.3	121	9.3	8.6
65	115	8.7	8.1	115	8.6	8.4
TOTAL 125	116	8.6	8.1	116	8.6	8.2

[2]

The difference between the control groups' and the experimental groups' scores was not significant at the .05 level of confidence. Comparing the total group mean score on arithmetic computation, the experimental group was one-tenth of a year above the control group. Peck indicated that these data seemed to refute the argument "that the modern approach to mathematics does not provide competency in number combinations and in applications to problem solving."[3]

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[1] Ibid.

[2] Ibid., p. 278.

[3] Ibid.

Two additional comparisons were made to test the hypothesis "that the modern approach to teaching of math will work best by introducing it to able groups."[1] The Stanford Achievement Arithmetic scores of students with Otis scores of 115 and above in the experimental group were compared with their counterparts in the control group. A similar comparison was made using students whose Otis scores were 114 and below. The following data were received:

MEAN OTIS INTELLIGENCE QUOTIENT AND MEAN STANFORD ARITHMETIC GRADE EQUIVALENTS

	CONTROL GROUP			EXPERIMENTAL GROUP		
n	Otis	Reasoning	Computation	Otis	Reasoning	Computation
75	122	9.1	8.5	122	8.9	8.3
50	107	7.8	7.5	107	8.0	7.7

[2]

The report of the data was:

> An analysis of the data indicated there are no significant differences at .05 level of confidence between the score for the control and experimental groups. It can be observed that the children in the lower ability experimental group did slightly better than their counterparts. In the higher ability groups, however, students in the control groups did slightly better than the experimental group.[3]

In concluding the report, Peck recommended more research and evaluation to be done in the areas of the teaching of modern mathematics in the elementary school.

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[1] *Ibid.*

[2] *Ibid.*

[3] *Ibid.*

The studies sighted are similar in nature, especially the Peck study, to the study performed by this investigator. Results of the latter will be reported in the following chapter.

CHAPTER III

SURVEY OF THE TEST RESULTS

The purpose of this study was to survey the mathematic scores on the Stanford Achievement Test received by the third grade and sixth grade students at Glick School, Marshalltown, Iowa, before and after the new mathematics program was established. The survey was to determine whether the new mathematics program had produced students with better computational skills and/or a better understanding of mathematics than students who studied arithmetic under the traditional program.

The scores from the two arithmetic subtests, Arithmetic Computation and Arithmetic Concepts, received in October, 1962, the last year before the new mathematics program was put in effect, and in October, 1966, were used for the comparison. As it was the policy of the Marshalltown Community Schools to administer the Stanford Achievement Test annually to all third grade and sixth grade students, the investigator obtained the scores from the students' individual accumulative school records. These scores were put in tabular form as found in the Appendix.

Table I shows that Groups _A_ and _B_ had higher mean raw scores on both Arithmetic Computation and Arithmetic Concepts than did Groups _AX_ and _BX_ respectively.

TABLE I

DATA USED IN COMPUTATION OF t-TEST FOR COMPARISONS OF SELECTED CLASSES, GLICK ELEMENTARY SCHOOL, MARSHALLTOWN, IOWA, 1962 AND 1966

		Arithmetic Computation		Arithmetic Concepts	
	n	Means	Σx^2	Means	Σx^2
GROUP A	31	37	1238	29	996
GROUP AX	39	29	1334	20	2736
GROUP B	41	27	1969	22	1749
GROUP BX	41	17	1230	16	948

The raw scores received by A on the two arithmetic subtests were compared with the raw scores received by AX on the two arithmetic subtests. The t-Test formula,

$$t = \frac{M_1 - M_2}{\sqrt{\left(\frac{\Sigma x_1^2 + \Sigma x_2^2}{n_1 + n_2 - 2}\right)\left(\frac{n_1 + n_2}{n_1 n_2}\right)}},[1]$$

was used for this comparison. The scores received by B and BX were likewise compared.

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[1]Burton G. Andreas, Experimental Psychology (New York: John Wiley and Sons, Inc., 1960), p. 85.

A t of 5.46 was obtained when the raw scores from the Arithmetic Computation test of A were compared with AX. When the value of t for a df of 60 equals or exceeds 2.00 there is a statistical significance at the .05 level of confidence, and when t equals or exceeds 2.66 there is statistical significance at the .01 level of confidence.[1] Thus, a t of 5.46 is significant at the .01 level of confidence and indicates that there is a likely difference between the computational skills of A and AX. The Arithmetic Computation tests' raw scores of B and BX were compared, with a resultant t of 7.15. This, again, is significant at the .01 level of confidence and indicates a likely difference between the computational skills of B and BX.

The mean raw scores on the Arithmetic Computation test for AX and BX were lower than those scores for A and B. This indicates that the computational skills of the students under the new mathematics program showed a significant decrease from those students who had studied under the traditional arithmetic program. These data uphold the teachers' presumptions that the computational skills of students studying under the new mathematics program are not so good as those students that studied under the traditional program.

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[1] *Ibid.*, p. 574.

In comparing the raw scores on the Arithmetic Concepts test between _A_ and _AX_ a _t_ of 5.06 was found and between _B_ and _BX_ a _t_ of 4.69 was derived. Both results are significant at the .01 level of confidence. The mean raw scores for _AX_ and _BX_ on the Arithmetic Concepts test were lower than the mean raw scores for _A_ and _B_. Thus, indicating a significant difference in reasoning skills between _A_ and _AX_, also _B_ and _BX_. This also indicates that the new mathematics program has not developed students with a better understanding of mathematics as compared to students of the traditional arithmetic.

Although both the computational skills and reasoning skills were lower for _AX_ and _BX_, further investigation of the data revealed a greater difference between the computational scores of _A_ and _AX_, and _B_ and _BX_. This tends to indicate that the computational skills of the students at Glick School have suffered more than their understanding of concepts has suffered since the new mathematics program was established.

CHAPTER IV

SUMMARY AND CONCLUSIONS

I. SUMMARY

It was the purpose of this study to determine whether the new mathematics program at Glick School, Marshalltown, Iowa, had produced students with better computational skills and/or a better understanding of mathematics. Justification for the research was based on quotations from teachers who had stated the idea that the students appeared to be gaining in mathematical understanding since the new mathematics program was established, but that the computational skills were not so good as those of students who had studied under the conventional mathematics program.

Literature related to the new mathematics was surveyed to establish the major reasons for the changes taking place in the mathematics curriculum and the main objectives of the new mathematics program, and to gain insight from investigations similar in nature to this research.

The intent of the research was to compare the scores received on the Stanford Achievement Test by the third and sixth grade students at Glick during the

1962-63 school year with the scores received by the third and sixth grade students at Glick during the 1966-67 school year. By the comparison of the two years (1962-63 being the year before the program was put in effect) it was possible to determine whether the teachers' presumptions were correct.

The *t*-test was applied to the raw scores received by *A*, *AX*, *B*, and *BX* on the Arithmetic Concepts and Arithmetic Computation subtests of the Stanford Achievement Test. Comparing the raw scores of *A* to *AX* and *B* to *BX* on the Arithmetic Concepts, *t*'s of 5.06 and 4.69, respectively, were obtained. The comparison of the Arithmetic Computation raw scores resulted in a *t* value of 5.46 for *A* to *AX*, and a *t* value of 7.15 for *B* to *BX*.

II. CONCLUSIONS

Investigation of the data indicates that the arithmetic computational skills and reasoning skills of the third and sixth grade students at Glick School, Marshalltown, Iowa, were significantly lower since the new mathematics superseded the traditional arithmetic program in September, 1963. The data also indicated that computational skills had suffered more than reasoning skills in the same period.

This conclusion is different from the studies of Peck and Arbego, which showed no significant difference in arithmetic skills between traditional and new mathematics. However, the latter studies involved a more immediate comparison between students' skills under traditional arithmetic and under new mathematics.

The investigator feels that further research and evaluation should be done to determine whether the new mathematics program as taught at Glick School will continue to produce students whose arithmetic skills are considerably less than the students of the traditional arithmetic program.

BIBLIOGRAPHY

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A. BOOKS

Allendoerfer, Carl B. Mathematics for Parents. New York: The Macmillan Company, 1965.

Andreas, Burton G. Experimental Psychology. New York: John Wiley and Sons, Inc., 1960.

Buros, Oscar K. The Sixth Mental Measurement Yearbook. Highland Park, N. J.: Gryphon Press, 1965.

Dutton, Wilbur H. Evaluating Pupils Understanding of Arithmetic. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1964.

Gans, Roma, Celia Burns, and Mille Amy. Teaching Young Children. Younkers, N. Y.: World Book Company, 1952.

Grossnickle, Foster E. and Leo J. Brueckner. Discovering Meanings in Elementary School Mathematics. Chicago: Holt, Rinehart and Winston, Inc., 1964.

Heimer, Ralph T., and Miriam S. Newman. The New Mathematics for Parents. Chicago: Holt, Rinehart and Winston, Inc., 1965.

Kramer, Klaas. The Teaching of Elementary School Mathematics. Boston: Allyn and Bacon, Inc., 1966.

Morton, Robert Lee, Merle Gray, and Myron F. Rosskopf, Modern Arithmetic Through Discovery: Book Two. Morristown, N. J.: Silver Burdette Company, 1965.

Providing for Individual Differences in the Elementary Classroom. Edited by Norma E. Cutts and Nicholas Moseley. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1961.

Skipp, Donald E., and Sam Adams. Developing Arithmetic Concepts and Skills. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1964.

Stroud, James B. Psychology in Education. New York: Longman, Green and Company, 1946.

Thorpe, Cleata B. Teaching Elementary Arithmetic. New York: Harper and Brothers, 1962.

Van Engen, Henry, Maurice L. Hartung, and James E. Stochl. Foundations of Elementary School Arithmetic. Chicago: Scott, Foresman and Co., 1965.

B. PUBLICATIONS OF THE GOVERNMENT, LEARNED SOCIETIES, AND OTHER ORGANIZATIONS

A Service Report for Schools. St. Louis: Webster Publishing Company.

An Analysis of New Mathematics Program. Washington, D. C.: National Council of Teachers of Mathematics, 1963.

Deans, Edwina. Elementary School Mathematics. Washington, D. C.: United States Department of Health, Education and Welfare, 1963.

Guidance Handbook for Elementary School. Prepared by the Division of Research and Guidance, Los Angeles: California Test Bureau, 1948.

Handbook of Research on Teaching. Edited by N. L. Gage. Project of The American Educational Research Association. Chicago: Rand McNally and Company, 1963.

Phillips, Harry L. and Marguerite Kluttz. Modern Mathematics and Your Child. Washington, D. C.: United States Department of Health, Education and Welfare, 1963.

C. PERIODICALS

Arbego, Mildred Brown. "Children's Attitudes Toward Arithmetic," Arithmetic Teacher, XIII (March, 1966), 206-208.

Broder, Max. "What About the New Mathematics?" High Points, XLVIII (January, 1966), 45-49.

Fehr, Howard F. "Modern Mathematics and Good Pedagogy," Arithmetic Teacher, X (November, 1963), 402-410.

Inbody, Donald J. "Helping Parents Understand New Mathematics Programs," Arithmetic Teacher, XI (December, 1964), 530-537.

Lynch, Lyla. "Arithmetic By Television," Arithmetic Teacher, X (January, 1963), 28-30.

Miller, B. R. "New Developments in the Teaching of Mathematics," National Association of Secondary School Principals Bulletin, XLIV (April, 1960), 87-88.

Peck, Hugh I. "An Evaluation of Topics in Modern Math," Arithmetic Teacher, X (March, 1963), 277-279.

Thelen, Herbert A. "Matching Teachers and Pupils," NEA Journal, LVI (April, 1967), 18-20.

Wright, Betty Atwell. "Anatomy of Change in Elementary Mathematics," Arithmetic Teacher, X (March, 1963), 158-161.

D. ENCYCLOPEDIA ARTICLES

"Methods of Teaching," Encyclopedia of Educational Research (rev. ed.), 745-752. New York: The Macmillan Company, 1950.

"Methods of Teaching," Encyclopedia of Educational Research (3rd ed.), 848-860. New York: The Macmillan Company, 1960.

APPENDIX

TABLE II

SCORES RECEIVED BY GROUP A, THIRD GRADE STUDENTS AT GLICK SCHOOL, 1962-1963, ON THE OTIS QUICK SCORING MENTAL ABILITY TEST AND STANFORD ACHIEVEMENT TEST

Otis	Arithmetic Computation		Arithmetic Concepts	
I.Q.	Grade	Raw	Grade	Raw
107	4.2	42	4.3	30
100	3.0	26	3.3	23
117	3.8	36	4.5	32
77	3.1	27	3.6	25
100	3.8	36	5.8	41
100	3.7	35	3.8	26
84	3.5	31	3.2	22
92	3.4	30	3.9	27
95	3.4	30	3.6	25
124	3.8	36	4.4	31
108	3.8	36	3.5	24
122	4.2	42	5.0	36
114	4.5	46	3.8	26
101	3.9	39	4.3	30
108	4.1	41	3.6	25
97	3.7	34	3.8	26
114	4.2	42	5.1	36
114	4.4	45	4.3	30
126	3.5	31	4.7	34
84	3.5	31	3.2	22
105	3.8	36	3.6	25
97	3.4	30	3.8	26
114	4.2	42	4.4	31
116	4.0	40	4.8	34
81	3.7	35	3.1	21
101	4.0	40	3.6	25
116	4.4	45	4.8	34
137	5.0	52	6.3	42
103	4.2	42	5.0	36
77	3.3	29	3.2	22
133	4.5	46	5.1	36
102	3.9	37	4.2	29

TABLE III

SCORES RECEIVED BY GROUP AX, THIRD GRADE STUDENTS AT GLICK SCHOOL 1966-1967, ON THE OTIS QUICK SCORING MENTAL ABILITY TEST AND STANFORD ACHIEVEMENT TEST

Otis	Arithmetic Computation		Arithmetic Concepts	
I.Q.	Grade	Raw	Grade	Raw
124	2.8	22	2.9	19
98	2.8	21	2.6	16
101	3.0	26	2.3	12
119	2.9	23	4.4	31
95	2.9	24	1.6	8
98	2.9	24	2.7	17
101	2.8	21	1.9	10
117	3.5	31	4.1	28
92	2.9	23	2.7	17
119	3.2	28	2.8	18
103	3.5	31	3.1	21
117	3.0	26	3.4	24
89	2.9	23	1.9	10
112	2.9	24	2.6	16
128	3.5	31	4.6	33
119	3.4	30	3.1	21
81	2.7	19	2.4	13
109	2.3	14	3.2	22
105	3.3	29	2.7	17
97	2.6	18	2.6	16
109	2.9	23	2.8	18
124	3.6	33	3.6	25
80	3.3	29	2.6	24
120	3.0	25	2.1	11
131	3.5	31	4.6	33
103	3.6	33	5.1	36
97	2.6	17	1.9	10
111	3.1	27	3.4	24
103	2.6	18	3.4	24
104	2.9	23	1.7	9
97	3.1	27	2.6	15
105	3.3	29	3.8	26
111	3.4	30	3.2	22
122	3.6	33	3.8	26
98	2.9	24	2.4	13
111	3.0	26	2.6	15
89	3.3	29	2.6	15
128	3.5	31	5.9	41
111	3.3	29	2.7	17
107	3.1	29	3.0	20

TABLE IV

SCORES RECEIVED BY GROUP B, SIXTH GRADE STUDENTS AT GLICK SCHOOL 1962-1963, ON THE OTIS QUICK SCORING MENTAL ABILITY TEST AND STANFORD ACHIEVEMENT TEST

Otis	Arithmetic Computation		Arithmetic Concepts	
I.Q.	Grade	Raw	Grade	Raw
103	7.4	25	5.4	11
103	9.6	32	7.3	20
112	7.4	25	7.3	20
97	7.4	25	5.6	12
96	5.8	16	6.5	16
116	10.5	34	8.5	25
103	7.9	27	9.5	27
112	8.6	30	9.5	27
107	10.5	34	9.5	27
95	5.4	14	6.5	16
103	7.7	26	7.0	19
125	8.4	29	9.5	27
121	8.6	30	9.5	27
131	11.2	35	9.5	27
107	8.4	29	8.8	26
103	3.8	7	4.3	7
113	6.8	23	7.0	19
106	7.1	24	5.4	11
115	10.0	33	9.5	27
116	7.9	27	8.8	26
128	7.7	26	8.5	25
113	10.5	34	9.5	27
102	6.8	23	7.6	21
109	6.0	18	6.8	18
113	7.1	24	7.6	21
109	6.0	18	5.9	13
114	7.1	24	5.4	11
118	10.0	33	9.5	27
112	9.6	32	10.3	28
124	10.0	33	8.2	24
126	11.2	35	8.8	26
113	10.5	34	10.3	28
97	9.1	31	8.8	26
115	7.9	27	8.5	25
132	9.1	31	8.0	23
119	9.6	32	10.3	28
99	7.1	24	6.8	18
89	4.4	9	4.0	6
103	6.0	18	7.6	21
125	10.0	33	9.5	27
132	10.5	34	11.1	29
112	8.2	27	8.0	22

TABLE V

SCORES RECEIVED BY GROUP BX, SIXTH GRADE STUDENTS AT GLICK SCHOOL 1966-1967, ON THE OTIS QUICK SCORING MENTAL ABILITY TEST AND STANFORD ACHIEVEMENT TEST

Otis	Arithmetic Computation		Arithmetic Concepts	
I.Q.	Grade	Raw	Grade	Raw
105	6.8	23	6.8	18
122	7.1	24	8.8	26
96	4.1	8	5.9	13
118	4.8	11	6.8	18
109	5.4	14	6.1	14
100	5.4	14	4.3	7
97	6.2	19	5.9	13
104	4.8	11	5.2	10
96	4.1	8	6.3	15
101	5.9	17	6.3	15
112	5.8	16	6.1	14
96	6.5	21	7.0	19
108	7.9	27	6.8	18
99	5.8	16	4.9	9
99	6.3	20	6.6	17
109	5.9	17	5.6	12
96	4.4	9	4.0	6
103	4.1	8	5.6	12
93	6.0	18	5.4	11
123	7.7	26	8.8	26
119	7.1	24	7.0	19
109	5.4	14	6.3	15
103	6.8	23	7.3	20
121	5.8	16	7.0	19
111	5.9	17	6.6	17
97	5.0	18	5.4	11
109	7.1	24	6.3	15
105	4.1	8	6.1	14
108	5.9	17	6.3	15
114	6.5	21	7.6	21
114	6.8	23	7.8	22
109	4.4	9	6.3	15
97	5.4	14	6.5	16
93	5.0	12	6.5	16
120	6.3	20	7.3	20
102	5.8	16	5.9	13
116	6.0	18	6.3	15
111	5.0	12	5.9	13
138	6.6	22	8.5	25
88	5.0	12	4.9	9
117	7.1	24	8.5	25
107	5.8	17	6.4	16